

China – The Role of Gas

An online panel event held on 3rd and 4th February 2021



A DATE WITH CHINA

“CHINA - Carbon Neutral by 2060: The Role of Gas”

Date: FEBRUARY 3 and 4, 2021
Time: 09.00-12.15 CET (both days)
4 online sessions...

- 1: Security of Supply**
- 2: Coal Phase-out**
- 3: Market Design**
- 4: Renewable Gases**

Co-Organiser:  **EU-CHINA ENERGY**
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Session Two: Gas for Power?

Participants

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Kevin Tu, China Expert, AGORA ENERGIEWENDE

Lauri Myllyvirta, Lead Analyst, CENTRE for RESEARCH on ENERGY & CLEAN AIR

Moderator: Christian Romig, Head of Management Consulting, China, AFRY

Highlights

All panellists agreed that the outlook for gas in China’s power market is limited, largely because of concerns about import dependency and the high cost of gas compared to coal.

Combined cycle gas turbine (CCGT) plants are likely to remain expensive to run, which means new plants will need multiple revenue streams, such as generating both power and heat, offering flexibility or taking part in potential capacity markets.

As China's electricity markets become more competitive, the role of CCGT plants will depend on the province - whether the provincial wholesale market can support investment, whether it's volatile because of intermittency or demand. Markets with volatility will want more flexibility, which could come from gas plants, batteries, interconnectors or other technologies.

China's new goal for carbon neutrality by 2060 could encourage the use of gas for flexible power, to replace coal, but would still be competing against renewable sources.

The main obstacles to gas

- Coal dominates the power market, gas supplies a tiny portion.
- The main concerns are that gas is expensive and will add import dependency.
- The Chinese government is concerned about relying on gas imports, in light of the US-China trade war.
- Increasingly affordable renewables could replace gas for peak shaving, reducing dependency.
- Chinese NOCs could kick off shale gas development, to increase domestic supply. But the US shale gas boom was driven by thousands of SMEs, not big oil companies.
- China needs to open competition in the upstream shale gas sector to spur development.

Climate policy and targets

- A zero-carbon power system will be based largely on renewables, leaving little room for unabated fossil fuel power generation.
- The challenge is to invest in the right infrastructure for the 2060 goal, not the wrong.
- CCUS could play a role on oilfields, because that gives a higher return on oil extracted.
- But CCS with gas will be less competitive to renewables, other low-carbon generation technology and power system flexibility.
- The 14th Five-Year Plan could conceivably foresee 150 GW of gas-fired power, recognising the flexibility gas plants provide. But that's small on China's scale.
- The EU's carbon border adjustment should be used as a tool to engage with China and set expectations, and as a punitive measure if Chinese emissions keep growing.
- The EU should articulate its expectations for China and create the capacity to independently monitor it.
- Imposing a carbon border adjustment mechanism risks eroding trust on climate change.
- Green hydrogen will have a role to play, but the energy losses in transferring renewable power into hydrogen and back are big.

Power market flexibility

- China's goal for 1,200 GW of solar and wind by 2030 adds pressure on the need for flexibility.
- The two most discussed alternatives to coal for flexibility are gas and batteries. Gas could be used especially in the next 10 years.

- Winter electricity shortages in some provinces also accentuates the need for peaking capacity.
- Gas could provide that peaking capacity - makes more environmental sense than coal, and won't be expensive if only used for peaking.
- But it would require pricing reform, because a flat tariff doesn't make sense for short peaking capacity.
- China needs to phase out coal. The danger of allowing gas to compete for peaking prices is that coal continues to be subsidised.
- Hydro is an excellent flexibility provider too. Cross-transmission between provinces needs to be improved in order to enhance its role.

Alternatives to coal

- Wind and solar still accounted for just less than 10% of China's power generation in 2020.
- To boost renewables integration, it needs to improve inter-provincial power trading.
- If heat was priced, it would help encourage the shift from coal to gas-fired CHP plants, and efficiency measures.
- The problem is it's still more competitive to use coal than gas for processed heat.

Carbon pricing

- China's national ETS launched on February 1, covering over 2,000 coal and gas power plants.
- But the carbon market's ability to drive fuel switching will be more limited than in Europe because gas is more expensive than coal in China.
- The theoretical fuel-switching price in China is at least €50, compared to €35-37 in Europe.
- Carbon taxation would work better than trading, in both China and Europe.
- In China a coal-fired power plant that is more efficient than the carbon market benchmark will still be paid for more than it generates, so there's no incentive for fuel-switching.
- The best way to incentivise less coal is to base benchmarks on gas instead of coal.

Session Two Summary



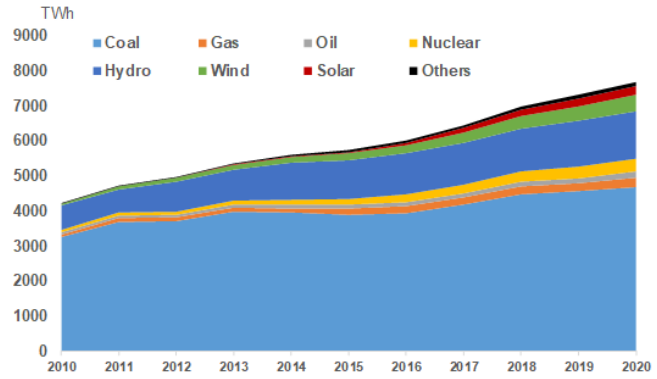
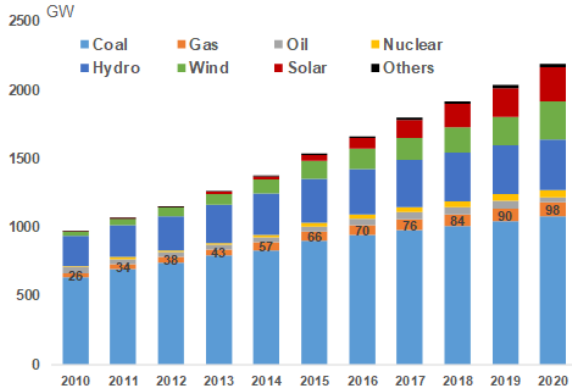
Yan Qin
Lead Analyst, REFINITIV

YQ: I wrote a report for the Oxford Institute for Energy Studies published in December 2020 on why China's power market has been very limited and the obstacles it faces.

Slow development of natural gas in China's power sector: 4.5% of total installed capacity

• 100 GW gas-fired capacity as of January 2021

In 2020: gas only 4% of total generation

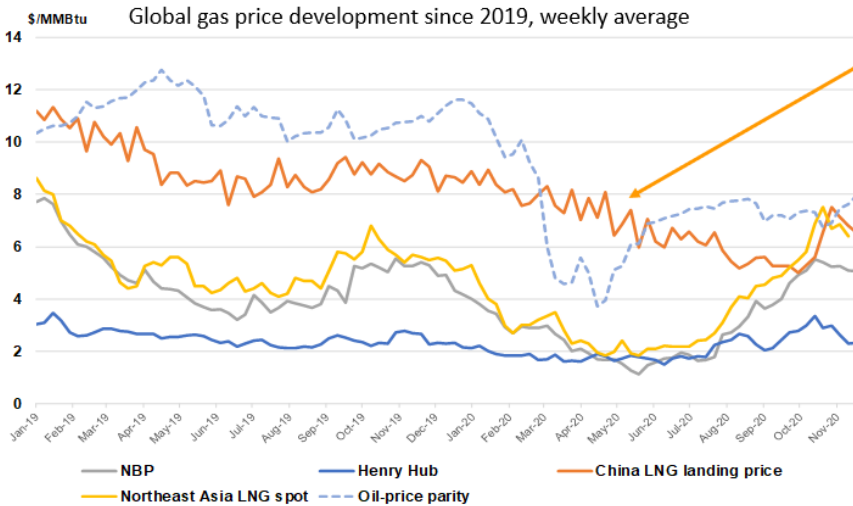


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Source: OIES, CEC

Gas capacity crossed 100 GW in mid-January, but it's still just a tiny portion of China's fleet. Coal is dominating.

Challenges: Expensive imported gas & Costly Turbine Technology



Fuel costs:

Turbine:
the latest H-class gas turbine would cost CNY2,300–2,400/kw, 30% higher than coal plants of the same class

Operations:
One major maintenance cycle could cost as much as \$60 million

Conversion of power plants from coal to gas generation rather uneconomical compared to retrofitting coal plants with ultra-low emissions tech

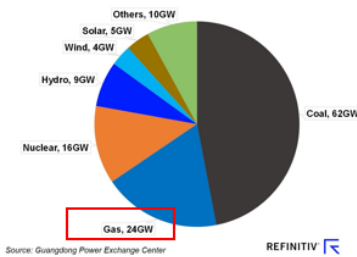
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Source: Refinitiv Eikon, SHPGX, Waterborne LNG Data

Whenever I speak to anyone working in the Chinese power sector about gas, the first words are “expensive”, “costly”. Expensive fuel, but what I find shocking is that turbine and operation costs are also high. Gas is losing its advantage compared to coal generation.

Challenges: Absence of competitive liberalized electricity markets

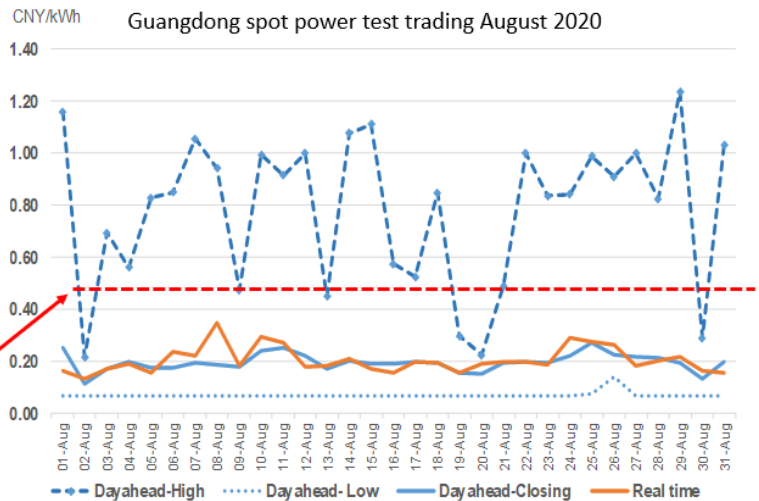
Guangdong province installed power generation capacity by June 2020



Average clearing price to CNY0.114–0.275/kWh per day during the month.

This is below the benchmark coal power price of CNY0.463/kWh, and far below the marginal costs of gas generators (CNY0.6–0.8/KWh)

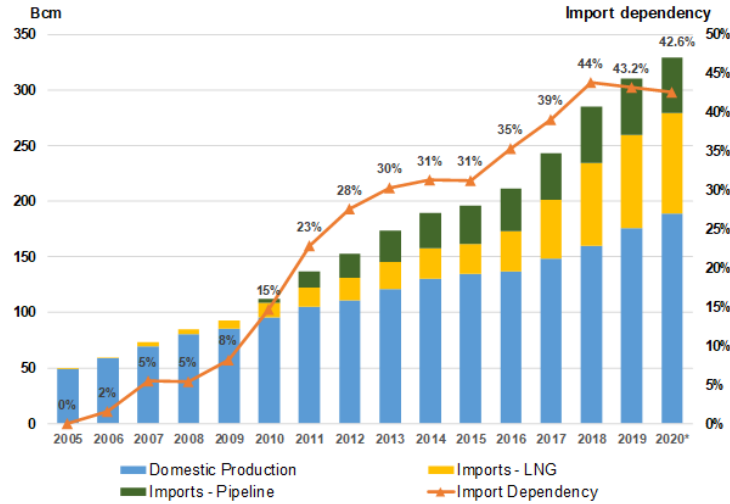
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China’s long-standing regulated power market is gradually opening up, eight provinces are conducting spot trading. But it’s in its infancy. Power prices at the spot market are even below the coal benchmark price, and gas - so we can see the strong advantage compared to gas generation.

Concerns over rising gas import dependency weigh on policy making

China natural gas consumption, domestic production and imports

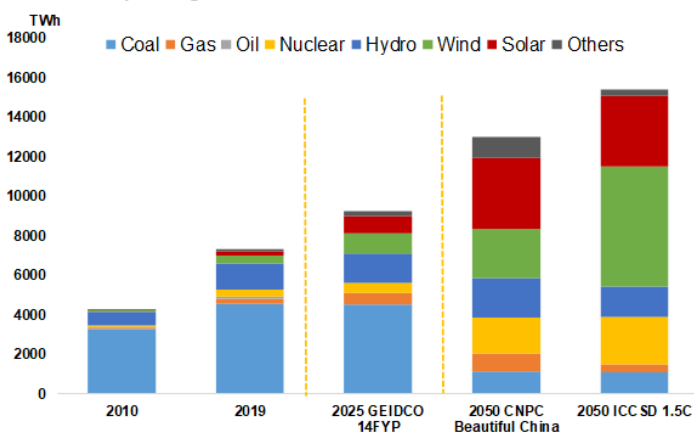


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Another key word we often hear is import dependency. Imports of gas are rising to more than 40%. So when you talk about building more gas plants, you will hear “but what about import dependency?” This is weighing on policy making as well.

China Gas to Power outlook: 150 GW by 2025? Long term?

China power generation mix in 2025 and 2050 scenarios



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Rapid uptake in renewables would also call for more flexible services, including gas.

To achieve 2060 carbon neutrality goal, China's power system would need to eliminate coal and reach zero-emissions by 2050, at the latest.

A zero-carbon power system will be based largely on renewables, leaving little room for unabated fossil power generation.

China last year announced a goal for carbon neutrality by 2060. To achieve the goal, China's power system will need to fully eliminate coal and reach net zero emissions by 2050 at the latest.

What role could gas play in this transition, with all the challenges? Leading institutes have said we may need 150 GW - meaning 50 GW of new coal by 2025. But my impression there is a lot of discussion on the advantages of gas, supporting flexibility of the power system, but there are a lot of obstacles as well.

Panel Discussion



Moderator: Christian Romig
Head of Management Consulting, China, AFRY

CR: In gas, China faces a 40% import dependency, and about 20% of domestic natural gas demand comes from the electricity sector. At the same time there are plans to build more gas generators - and that obviously will ramp up demand for gas in China.

It would seem that there are two competing priorities: with concerns about energy security on one side and plans to develop more gas in the electricity sector on the other. Is there a way these competing priorities can work side by side?



Kevin Tu
China Expert, AGORA ENERGIEWENDE

KT: Last year as China's economy grew by 2.3% the whole year, energy consumption grew similarly, by 2.2%. Gas production increased by 9.8%, gas imports by 5.3%. So we are talking about a gas consumption increase of around 7%.

This has largely been compatible with the Chinese government's intention to increase indigenous gas consumption. If China could further reform its highly monopolised upstream gas sector, the country could increase its gas domestic production. But if we look at international trade - because of the US-China trade war - China is extremely concerned about over-reliance on LNG imports, especially shale gas imports from the US.

Take what happened to Huawei, for example. From this perspective China is also likely to limit its gas consumption in non-essential fields, and power is a candidate, also because increasingly affordable renewables can replace gas for peak shaving.



Kaare Sandholt
Chief Expert, CHINA NATIONAL RENEWABLE ENERGY CENTRE

KS: From my point of view, it is very difficult to see a big role for nat gas in the power sector. What we've seen mainly so far is evolution to replace coal with gas.

For flexibility, what is needed is a functioning power market in China. As soon as that happens, coal power plants would be very interesting in delivering flexibility, as we've seen in Europe.

The challenge is to avoid investing too much in the wrong infrastructure and invest in the right infrastructure order to reach the 2060 target. In my opinion, renewables is the right place to invest.



Lauri Myllyvirta
Lead Analyst, CENTRE for RESEARCH on ENERGY & CLEAN AIR

LM: Main use of gas so far is in household heating and industrial boilers in the industrial sector. You can use electricity for household heating, ground source heat pumps make the most sense.

Recently, because of the energy security concerns and dual circulation economic policy, there's been a shift to using a processed form of coal instead of gas in household heating conversion projects. But for those two reasons, I don't think gas will be the mainstay of future conversions.

Additionally, electricity shortages in some provinces in winter puts pressure on the need for peaking capacity. Using gas as peaking capacity makes more environmental sense than coal, and if you're using it exclusively for peaking it won't be expensive - you won't burn a lot of gas. But that would mean reforming the pricing system, because when everyone runs on a flat tariff it doesn't make sense to run for a short time.

CR: What are the alternatives to CCGT for flexibility that we should start with instead?

YQ: Improving the power system's flexibility - or renewables integration - is very important right now, especially as China pledged to have 1,200 GW of solar and wind capacity by 2030.

What's been discussed mostly, besides gas, is battery storage. In the next 10 years, from a cost-effective perspective, I see gas generation used for flexibility and reducing pollution. I believe in the next five to

10 years we could see slightly a rosier outlook for gas generation, but only slightly because the obstacles remain.

KS: There are two ways to look at it. One is to create flexibility. There's huge potential to create flexibility in coal-fired power plants, as long as they have incentive.

The other is that China needs and wants a controlled phase-out of coal. From that perspective, if new gas-fired power plants grab in on the market for high-priced peak electricity, they deteriorate the economics of coal power. Then you continue to have a bad market or directly subsidise the coal power market. It's a lose-lose situation. Batteries and other technology will be affordable in the future, but right now it's not needed.

The massive deployment of electric vehicles in China would give a lot of flexibility.

KT: I agree with Kaare, that it's important to provide market incentives. The Chinese spot trading market needs to provide price signals, then even nuclear generators would be eager to participate.

Although China has the largest renewable energy market in the world, wind and solar together in 2020 only accounted for less than 10% of national power generation. So if China could really improve interprovincial power trading - inter-grid trading especially - then it could significantly increase the integration of renewables into the grid.

LM: Huban, of the provinces with the biggest electricity shortage this winter, was importing power from far away and couldn't import it from a neighbouring province that had spare capacity.

There are places where you need more transmission capacity - the situation in Huban was an example - but for the most part even when the capacity exists, it's simply a matter of running the grid that way.

CR: In Europe, the economics of gas in electricity were helped by the introduction of carbon pricing. Can we expect the same thing now that we're accelerating the national launch in China, and what kind of carbon price is needed?

YQ: On February 1, China's ETS launched, covering over 2,000 coal and gas plants. But the role of carb pricing - as in Europe - is to drive fuel switching. The European carbon price is now around €35-37 per tonne, and this has been putting pressure on and squeezing coal out of the generation mix.

Can we see this European fuel switching in China? The answer is limited. Even if we have full economic dispatch for power generation, because gas is more expensive and coal is cheaper, the theoretical fuel switching price - the carbon price - is probably twice Europe's, say €50 at least.

At least now we can say that fossil fuel power plants are in the carbon market and will be under pressure from it. It's starting to have an impact but will take time, we'll need other policies in place.

KT: In the Chinese power sector, emissions trading is more like an efficiency market. It will help the power sector increase generation efficiency. Then Chinese decision makers will realise it's extremely difficult to extend carbon trading beyond the power sector.

In my opinion, emissions trading in the power sector is a great instrument for China to experiment with. But for both China and Europe, carbon taxation would work much better than carbon trading.

LM: The carbon price in the Chinese trading system doesn't mean anything like it does in Europe. A coal-fired power plant that is more efficient than the benchmark will get paid more than it generates - so there is no carbon price at which there's fuel switching. Because the system is based on benchmarks, the most natural way to incentivise less reliance on coal would be to base benchmarks on gas instead of coal.

KS: We should look at the ETS as a very long-term mechanism. It's good that it's getting started, it gives incentives for monitoring, transparency, etc. But the mechanism as it is now will not move anything.

CR: Almost every gas plant in Chinese electricity market is a CHP, so it's making money from heat as well as from energy. How important is heat for gas in future?

KS: Both for gas and for coal-fired power plants, it's important that heat gets priced. Also for energy efficiency measures, it would be necessary to price heating for buildings and so on. The main issue is industrial CHP - it would be interesting for moving away from coal.

LM: It's interesting to look at what's happening in the heating sectors in Nordic countries. China is where Finland, Sweden, and to a lesser extent Denmark were 10 years ago. Where you still have a lot of coal and gas, thermal power in the system. So the more you can generate with CHP, even coal, makes sense for emissions.

But we went very fast to the point where that doesn't make sense. Then it starts to make more sense to start deploying large-scale heat pumps for district heating - which is also energy storage.

KT: It's generally difficult to transition the heating sector away from coal. In rural regions in northern China, the government has subsidised heavily to transition heat from coal to gas. The problem is, once subsidies ended some households couldn't afford gas. Industry faces similar issues. It's still more competitive to use coal than gas for processed heat. The question is how the government could use command-and-control market mechanisms to incentivise moving processed heating away from coal.

CR: We do need to have something that is dispatchable to maintain system inertia. Gas can play that role, but it's not possible without CCS, if the 2060 commitment is met. What is the role of CCS in decarbonisation targets? Could gas with CCS survive on an economic basis out to 2060?

YQ: There are a few CCS pilot projects, but they're very costly. I sense a priority for CCUS on oilfields, because then you get a higher return on the oil extracted. I do not expect CCS to be a priority. Renewables or low-carbon generation technology and power system flexibility would come first.

KT: There are some similarities between CCS and hydrogen. CCS utilised in the power sector leads to about a 25% efficiency reduction. It's the same for hydrogen, because it's a second source, converted from other energy sources.

If there is a better alternative it would be preferred than using CCS or hydrogen. Where technological breakthroughs aren't made, CCS could be used.

Q&A

Louise Anderson asks: Is gas really that important for China, given the high level of hydro in the country? In the event those pilot markets become reality, I would say hydro would provide more flexibility, so is gas really needed?

KS: Hydro is an excellent provider of flexibility, it could be used more to help these power markets work and ensure transmission lines are used. The use of cross transmission between neighbouring provinces really needs to be improved to give hydro the role as a flexibility provider.

KT: Pumped hydro storage is the best option in terms of peak load shaving in the grid. It's not very easy to develop this sort of hydro project, because it depends on geonautical formations. In 2020 it only accounted for 1.2% of China's power generation capacity, and it only provided 0.4% of national power output. Indeed, it's a greater technology in terms of flexibility, but it only has a certain role to play in China's power grid.

CR: Another challenge for pumped hydro is ownership. It is owned by the grid itself and delivers its flexibility outside the early flexible markets. How that will play out in the long term will impact on the revenue stream the other flexible generators will be able to access.

Kriti Samriwal asks: Can we conclude that the 14th Five Year Plan will adopt favourable policies supporting gas over coal? Or will there be greater emphasis on coal until we move to clean renewables?

LM: If you speak to most Chinese businesses, dual circulation and energy security are much bigger issues. So the idea of continuing to expand gas ahead of domestic supply the way it has in previous five-year plans isn't going to fly.

For example, 150 GW - a reasonable guess - is still something, but it's not a big increase on the scale at which things happen in China.

YQ: 150 GW is my take from what I observe. But there are many moving parts, so it still depends on the policy. I'm slightly positive because I think the value that flexible gas plants can provide is important and recognised. Developments could be uneven across provinces.

“Anonymous” asks: Like the US, China has large reserves of shale gas yet to be developed. Is there any scope for the development and use of shale gas, or will development be hindered by environmental protection issues?

KT: Major national oil companies are trying hard to transition their business models from ‘oil and gas producer’ to ‘gas and oil producer’. All three NOCs have developed seven-year plans for themselves to 2025, and include an increase in shale gas production.

The problem is, while China can kick off shale gas development with those NOCs because they have profound expertise, the US success did not come from big oil companies. It came from thousands of SMEs. In order to kick off shale gas development and duplicate the US success, it's important for China to open competition in the upstream shale gas sector. Upstream oil and gas reform is a prerequisite for shale gas development.

Erik Rakhou asks: Europe is considering a carbon border adjustment mechanism and the COP26 climate summit is coming up this year. How do you see the carbon border adjustment being introduced and influencing a faster transition out of coal in China? What would be the preconditions?

LM: The carbon border adjustment in a traditional economic framework is not an effective tool. But it can be part of an approach to engage with China or create a relationship where it's clear that the EU is prepared to engage and collaborate when China lives up to expectations. It's also important to have punitive measures if emissions growth in China continues. What the EU should do is articulate the expectations it has for China and create capacity to independently monitor what China is doing.

KT: Border adjustment taxation is like a nuclear weapon - all major economies have a right to talk about it, to design it, to debate about it. But hopefully no one will impose it, otherwise it becomes a nightmare for climate relationships - the trust is lost.

YQ: I think the EU's discussions are starting to have an impact on the mindset in China's industry, in the domestic debate as well in the context of the 2060 carbon neutrality goal. Baowu Steel recently announced it will peak emissions in 2025 and reach net zero by 2050. This discussion is having an impact and will raise awareness among heavy polluters about carbon cost, and one of the measures will be reduced coal usage.

Sanjay Wele asks: What's the role of hydrogen in China's future electricity sector?

KS: In the long term, there's no doubt hydrogen will have a role to play in the energy system, as a green energy carrier. But it's important to look into the energy costs - the losses from transferring electricity

into hydrogen and back to electricity - are huge. It's not a technology that should be implemented soon, but clearly in the long-term it will have a place in China's energy system.

KT: In a carbon neutral world, hydrogen in the power sector will have to come from zero carbon sources, solar or wind. Then we're talking about substantial efficiency loss. Downstream, zero-carbon hydrogen may not flow back to the power sector, it might be used as fuel cells in households. It depends how energy is structured in a carbon neutral world. There are lots of uncertainties.

CR: We're quite clear on the key issues facing gas in the electricity sector. There will be a role for gas in China's future electricity sector, but it will be constrained by a number of factors.

CCGTs are likely to remain expensive, mainly because of the high input costs of natural gas in China, which makes up the vast majority of the variable costs of running CCGTs. New plants will need to come forward and access multiple revenue streams - heat, flexibility and there are discussions and plans for capacity markets. Heat is important, so we'll see new gas plants near industrial and urban centres.

As we move towards competitive electricity markets in China, the role of CCGTs provincially will depend on whether the wholesale markets can support the investment, and whether they are volatile because of intermittency or volatile demand. That will depend on the market design, and whether volatile prices are even allowed. Where we see that volatility, there will be demand for flexibility, for voltage support and in the long term for inertia. As the provincial electricity systems transition from coal, those services will be in demand - they can be met by batteries, interconnectors and other technologies, but some will be met by gas.

If you put all of these together, we end up concluding there will probably be a moderate expansion in CCGT. But this is likely to be constrained to coastal regions, where prices are a bit higher and where there's access to gas, and the role will continue to be for peak.

Summary compiled by [Sara Stefanini](#)

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